DOCUMENT RESUME

ED 182 173 SE 029 962

TITLE	Real Growth Unlikely in 1980 Federal R&D Funding. Science Resources Studies Highlights.
INSTITUTION	National Science Foundation, Washington, D.C. Div. of Science Resources Studies.
REPORT NO	NSF-79-319
PUB DATE	16 Nov 79
NOTE	7p.; Not available in hard copy due to marginal legibility of original document
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Budgets; Federal Aid; Federal Government; *Federal Legislation; *Federal Programs; Financial Support; Scientific Research; Technological Advancement; *Technology; Technology Transfer

ABSTRACT

Presented are data taken from the Federal Funds for Research and Development, Volume 28 survey conducted in the second quarter of fiscal year 1978, shortly after the President's 1980 budget message in January. The following highlights of the budget are presented: (1) an increase in Research and Development (R&D) allocation by 4% over 1979; (2) decreases in R&D funding for five of the 12 leading R&D support agencies, whereas in 1979, all 12 had reflected gains; (3) increases by Congressional actions on the 1980 budget in these areas over amounts originally requested (National Institutes of Health, National Aeronautics and Space Administration, and Department of Agriculture); (4) an increase of 8% in overall basic research obligations, while applied R&D obligations were held to increases of 6% and 2%, respectively; (5) a break in a 3-year growth trend in R&D funding for universities and colleges, in which a less than 5% increase is provided over 1979. Discussions and accompanying tables provide details regarding R&D trends, 1980 program changes, performers and character of work, and fields of science supported. (CS)

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SCIENCE RESOURCES STUDIES HIGHLIGHTS

NATIONAL SCIENCE FOUNDATION WASHINGTON, D.C. 20550 NOVEMBER 16, 1979 NSF 79-319

Real Growth Unlikely in 1980 Federal R&D Funding

The following data are taken from the Federal Funds for Research and Development, Volume XXVIII survey which was conducted in the second quarter of fiscal year 1979, shortly after the President's 1980 budget message in January. Data are based on this budget; they are actual for 1978 but reflect estimates for 1979 and requested amounts for 1980. Later legislative and executive actions will change, by varying degrees, the amounts shown below for the latest two years.

Highlights

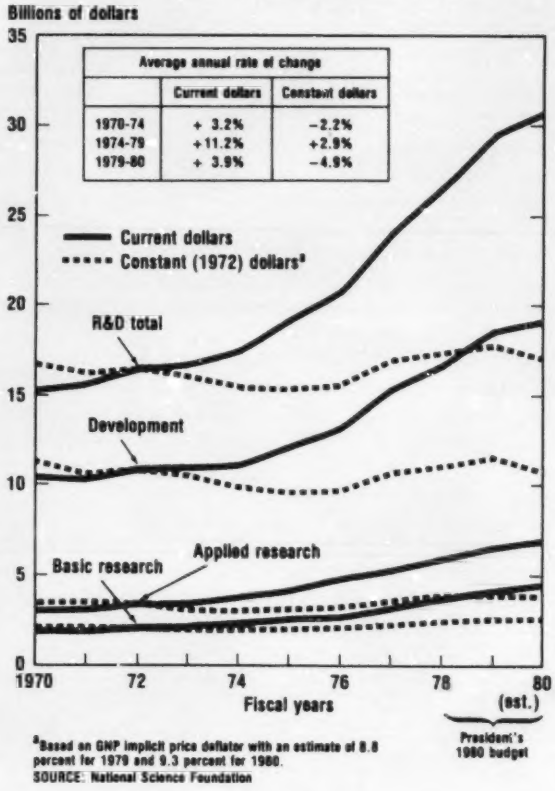
- The President's proposed 1980 budget, reflecting an overall policy of fiscal restraint as a counter-inflationary measure, provided for an increase in R&D obligations of 4 percent over 1979. The 1980 R&D total of $30.7 billion was 5 percent lower in real terms than the 1979 obligational total (chart 1).

- The degree of austerity in the 1980 budget is seen in the fact that of the 12 leading R&D support agencies, 5 showed decreases in R&D funding requests even before adjusting for inflation. All 12 of these agencies had reflected gains in 1979—9 of them ahead of the rate of inflation.

- Congressional actions on the 1980 budget point to increases in some areas over amounts requested in the budget. An increase has already been established for the National Institutes of Health (NIH) within the Department of Health, Education, and Welfare (HEW). For National Aeronautics and Space Administration (NASA) a budget amendment covering additional funding for the space shuttle has already been agreed to by Congress, and all other program requests have been granted. For the Department of Agriculture (USDA) both houses of Congress have made increases in requested R&D program levels with the exact amounts awaiting resolution. In the case of DOD some R&D increases over amounts originally requested may result from congressional additions to the defense budget. Based on information on budget action for Federal R&D programs presently under consideration by the Congress, however, the final overall R&D total for 1980 will still fall below 1979 in real terms.

- Basic research represented the chief exception within the R&D portion of the budget to administration efforts to hold down Government spending in 1980 (table 1). With the purpose of ensuring real growth in Federal basic research support, the budget included an increase of 8 percent in overall basic research obligations while applied research and development obligations were held to increases of 6 percent and 2 percent, respectively. The proposed $4.5 billion total, however, will not permit real growth in Federal basic

Chart 1. Trends in Federal R&D obligations



[a]Based on GNP implicit price deflator with an estimate of 8.8 percent for 1979 and 9.3 percent for 1980.
SOURCE: National Science Foundation

Prepared in the Government Studies Group, Division of Science Resources Studies

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Table 1. Federal obligations for research and development by character of work: FY 1970-80

(Dollars in millions)

Fiscal year	Total	Research		Development
		Basic	Applied	
1970	$15,340	$1,887	$3,064	$10,389
1971	15,545	1,957	3,294	10,294
1972	16,498	2,179	3,414	10,905
1973	16,800	2,211	3,435	11,154
1974	17,415	2,365	3,855	11,195
1975	19,047	2,591	4,258	12,198
1976	20,789	2,759	4,865	13,165
1977	23,995	3,256	5,359	15,380
1978	26,414	3,699	6,052	16,663
1979 (est.)	29,576	4,205	6,684	18,687
1980 (est.)	30,733	4,538	7,056	19,140

Note: Detail may not add to totals because of rounding.

Source: National Science Foundation.

research funding if current estimates for inflation in 1980 are correct.

- Universities and colleges have shown steady current-dollar R&D funding growth throughout the 1970-80 decade, but only between 1976 and 1979 was there an upward trend in constant dollars. The 1980 budget, as submitted to the Congress, would result in a break in the 3-year growth trend by providing for less than a 5-percent increase over 1979 in Federal R&D obligations to the academic sector.

R&D Trends

The rapid advance in Federal R&D support that began after 1974 and continued through 1979 appears to be interrupted with the 1980 budget. From 1974 to 1979 the average annual increase of 11.2 percent was equivalent to real growth of 2.9 percent. The administration budget for 1980, however, with an increase of only 4 percent, represented a return to the 1970-74 pattern of declining levels of R&D funding in constant-dollar terms. Even after congressional additions to program funds, the indications already are that recent annual rates of growth will not be matched.

Within these broad trends research has been growing faster than development. In the 1980 budget the share of funding for development is an estimated 62 percent of the R&D total, and the share of research is 38 percent. Ten years previously the development share was higher—68 percent, and the research share lower—32 percent. The basic research share is an estimated 15 percent now compared with 12 percent in 1970—a significant change in view of the fact that each gain in a percentage point has represented between $250 million and $300 million in recent years.

Share of the Federal Budget

Since 1975 the share of R&D and R&D plant outlays within the overall Federal budget has changed only slightly from year to year; the estimated share for 1980 is 5.8 percent compared with 6.0 percent in 1975. In 1970 the share was 8.0 percent, with the subsequent decline produced by decreases or slow growth in R&D support in the early seventies and a rapid rise in overall budget funding, especially for social programs, since 1974.

Viewed in relation to those budget outlays that are defined as *relatively controllable*, R&D and R&D plant outlays have represented a share that ranged between 13 percent and 15 percent in the past decade. Relatively controllable outlays are subject to annual authorization and appropriation actions that require new decisions as distinct from relatively uncontrollable outlays where program levels of fixed cost and open-ended programs[1] under trust funds are largely mandated by existing statutes although some appropriations are made for administrative and other program costs. In the 1980 budget R&D and R&D plant outlays make up an estimated 14.1 percent of the relatively controllable part of the budget, compared with 13.7 percent in 1970, an indication that R&D programs continue to be considered an integral part of Federal mission performance.

1980 Program Changes

In the proposed 1980 budget R&D obligations were expected to rise by $1.2 billion over 1979, the smallest dollar increase in six years (table 2). Three-fourths of this increase was attributable to defense-related R&D programs. Even so, the share of DOD within the Federal R&D total was only slightly higher, at 45 percent, than in 1978 and 1979. The Department of Energy (DOE) and NASA each accounted for 15 percent of all Federal R&D program funding in 1980 and HEW, for 12 percent. Together these four agencies have accounted for almost 9 out of 10 Federal R&D dollars obligated during the past decade.

DOD Plans for DOD programs resulted in an overall R&D funding increase of 7 percent in 1980.[2]

Air Force programs reflected greatest relative growth (a 12-percent increase), chiefly influenced by the M-X strategic missile program, which showed the largest

[1] Social security, health insurance, veterans payments, public assistance, interest, and other programs. See *The Budget of the United States Government, Fiscal Year 1980* (Washington, D.C. Supt. of Documents, U.S. Government Printing Office, 1979), pp. 560-1. The Office of Management and Budget (OMB) considers outlays for regularly authorized programs that result from prior-year contracts and obligations as also relatively uncontrollable; these include R&D programs. NSF, however, considers R&D and all other programs not covered by existing substantive law to be relatively controllable. R&D programs are not, for the most part, acted upon as a separate budget item but are part of larger appropriations. Moreover, they are not voted on as a given share of the relatively controllable budget. After all decisions are made, the share of R&D programs within the budget is calculated for purposes of analysis.

[2] DOD made a supplemental request of $523 million for 1979, of which only $198 million was granted by the Congress, nearly all for strategic programs of the Air Force. The congressional decision not to grant the remainder of the DOD supplemental request lowered the DOD 1979 R&D total, resulting in a revised estimated increase of 9 percent for DOD in 1980.

Table 2. Federal R&D obligations by agency
(Dollars in millions)

Agency	Actual			Estimated			
	1970	1978	Av. annual percent change 1970-78	1979	Percent change 1978-79	1980	Percent change 1979-80
Total	$15,340.3	$26,414.3	+7.0	$29,576.0	+12.0	$30,732.9	+3.9
Department of Defense	7,360.4	11,553.6	+5.8	13,001.5	+12.5	13,879.7	+6.8
Department of Energy	[a]1,346.0	4,244.8	+15.4	4,688.5	+10.5	4,658.8	−.6
National Aeronautics and Space Administration	3,799.9	3,875.4	+1.1	4,392.3	+13.3	4,540.0	+3.4
Department of Health, Education and Welfare	1,221.0	3,207.3	+12.8	3,665.4	+14.3	3,725.8	+1.6
National Science Foundation	289.0	748.8	+12.6	818.9	+9.4	910.1	+11.1
Department of Agriculture	281.2	621.3	+10.4	666.9	+7.3	663.7	−.5
Environmental Protection Agency	88.5	384.6	+19.5	400.4	+4.1	435.6	+8.8
Department of the Interior	157.9	385.2	+11.8	435.0	+12.9	417.3	−4.1
Department of Transportation	327.8	408.3	+2.5	418.2	+2.4	395.1	−5.5
Department of Commerce	121.6	283.7	+11.2	319.1	+12.5	322.0	+.9
Nuclear Regulatory Commission	—	133.9	—	151.6	+13.2	176.3	+16.3
Veterans Administration	58.6	114.0	+8.7	127.3	+11.7	126.5	−.6
Other agencies	288.5	453.4	+5.8	490.9	+8.3	482.1	−1.8

[a] Atomic Energy Commision, including functions of the Nuclear Regulatory Commission.

Source: National Science Foundation.

relative and absolute growth of any DOD program. Other expanding Air Force programs included the NAVSTAR global positioning system (shared with the other services), the E-3A airborne command and control system (AWACS), the satellite communications system, B-52G/H avionics modernization, the AMRAAM missile, the ground-launched cruise missile, and support to the space shuttle. The advanced ballistic re-entry system program is leveling off, and air-launched cruise missile (ALCM) funding is now declining as development reaches later stages.

Navy R&D funding reflected an overall decrease (2 percent) in the 1980 budget because a number of large programs have moved beyond the peak of development: the Trident submarine and Trident I strategic missile system, the F/A-18 combat fighter (Hornet), the Tomahawk cruise missile weapon system, and the Aegis surface-to-air missile system. Declines in funding for these programs were not completely offset by increases planned for the LAMPS III helicopter, standard MR air defense missiles, the ASW torpedo, the Phoenix air-to-air missile system, and the HARM air-to-surface missile.

Army programs, by contrast, showed a 10-percent rise overall. Contributing to the increase were plans for continued development of the advanced attack helicopter (AAH), the Pershing II missile system, the general support rocket system, and the standoff target acquisition system. The two large Army strategic programs showed level funding; these are the BMD advanced technology and BMD systems technology programs. The Patriot (SAM-D) air defense missile system showed reduced funding as development nears completion.

DOE The R&D efforts of this agency were scheduled in the 1980 budget proposal for a 1-percent decrease, which stemmed principally from decreases of 15 percent and 9 percent, respectively, in the nuclear fission and fossil fuels programs. Most other DOE program areas showed increases.

On the energy side of the DOE mission, nuclear fission programs account for 25 percent of the energy R&D total, and within these a large cut was proposed in breeder reactor systems. A $111 million decrease in the liquid metal fast breeder reactor program (LMFBR) included an administration proposal to terminate the Clinch River breeder demonstration project, and Congress concurred in this decision after a 2-year period of debate but appropriated funds for alternative breeder experiments. The converter program (nonbreeder reactor technology) was scheduled for a decrease, which Congress reversed by raising the requested increase for the thermal reactor subelement. The commercial waste management program had reflected a large requested increase for terminal isolation R&D efforts; Congress granted this in part.

Fossil fuel R&D efforts account for 21 percent of the energy mission of DOE, and reductions in this program area were proposed for demonstration of enhanced oil and gas recovery and coal conversion technologies. Emphasis continued to be placed, however, on coal liquefaction, surface coal gasification, and advanced environmental control technology.

Solar energy programs now account for 14 percent of the energy R&D effort of DOE, and these showed an 11-percent increase in the 1980 budget. Congress has granted the funds requested. The magnetic fusion R&D program, next in size, reflected an 8-percent increase,

but funding was cut back to approximately the 1979 level. Environmental R&D efforts were also proposed for growth, whereas energy conservation R&D funding was to level off and geothermal R&D efforts reflected a decrease. Congress concurred in the case of environment and reduced the geothermal program further; conservation awaits final action.

The DOE defense mission virtually leveled off. Within it, however, an increase was shown in the budget for weapons R&D testing, the largest program area, while naval reactor development, the next largest program, reflected a decline. Greatest growth, 61 percent, was proposed in defense waste management, although subsequent congressional action has considerably reduced the increase.

NASA Funding for NASA was scheduled to increase 3 percent overall in the 1979 total, but a later budget amendment of $220 million for 1980 that was granted by the Congress along with other NASA requests now places the increase at 8 percent.

Space transportation systems is still the largest NASA program area, covering the space shuttle effort, space flight operations, and work on expendable launch vehicles. The space shuttle is moving from the design and development phase to the production phase, and although a considerable decrease (16 percent) was shown in funding in 1980, the shuttle still represents 30 percent of the NASA R&D effort. Next in size of support is space science, applications and technology, scheduled for a 14-percent increase. Within this program area space science included increased funding for the Earth-orbiting space telescope, and the international solar polar mission as well as for the Galileo mission, which encompasses direct and long-duration studies of Jupiter, with a launch scheduled by the space transportation system in 1982. NASA applications cover resource observations, including development of the Landsat-D satellite to expand the use of space data for agricultural, water resource, and other purposes and environmental applications, such as the earth radiation budget experiment. The third broad program area is the NASA aeronautical research and technology effort with a 9-percent increase proposed; emphasis is placed on reduction of aircraft noise and fuel consumption, as well as on strengthening the technology base. Tracking and data acquisition, the fourth area, reflected a 9-percent increase in the 1980 budget.

HEW In 1980 the R&D programs of HEW were permitted by budget plans to increase less than 2 percent overall, but subsequent congressional actions now indicate an increase of approximately 8 percent.

Four-fifths of the R&D effort within HEW is undertaken by the National Institutes of Health (NIH) in biomedical research. The 11 institutes showed level funding in the budget from 1979 to 1980 in contrast to rapid growth in recent years. The largest relative increase was that proposed for the population research program of the National Institute of Child Health and Human Development, up 9 percent. Research on cancer and on heart, lung, and blood diseases now represents almost one-half of all NIH biomedical research. Congress has raised the overall NIH request by approximately $240 million, notably for research on aging, neurological diseases, arthritis, allergies, and general medical problems.

A substantial increase (19 percent) was scheduled for the Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA), reflecting the recommendations of the President's Commission on Mental Health, but Congress cut back the request so that the increase is now 10 percent.

The National Institute of Education (NIE) and the Office of Education (OE), together accounting for 3 percent of the HEW R&D total, reflected a virtual leveling off in funding except for an OE increase in bilingual education.

NSF R&D obligations of the National Science Foundation (NSF) were expected to rise 11 percent in 1980. Most NSF R&D activity is in the form of support to basic research in all the major fields of science. Significant increases were shown in each area. Science education development and research was scheduled for a 22-percent increase. For the applied science and research applications (ASRA) program, however, a leveling off was planned. Congress reduced the research total slightly, resulting in a 10-percent increase for NSF in 1980.

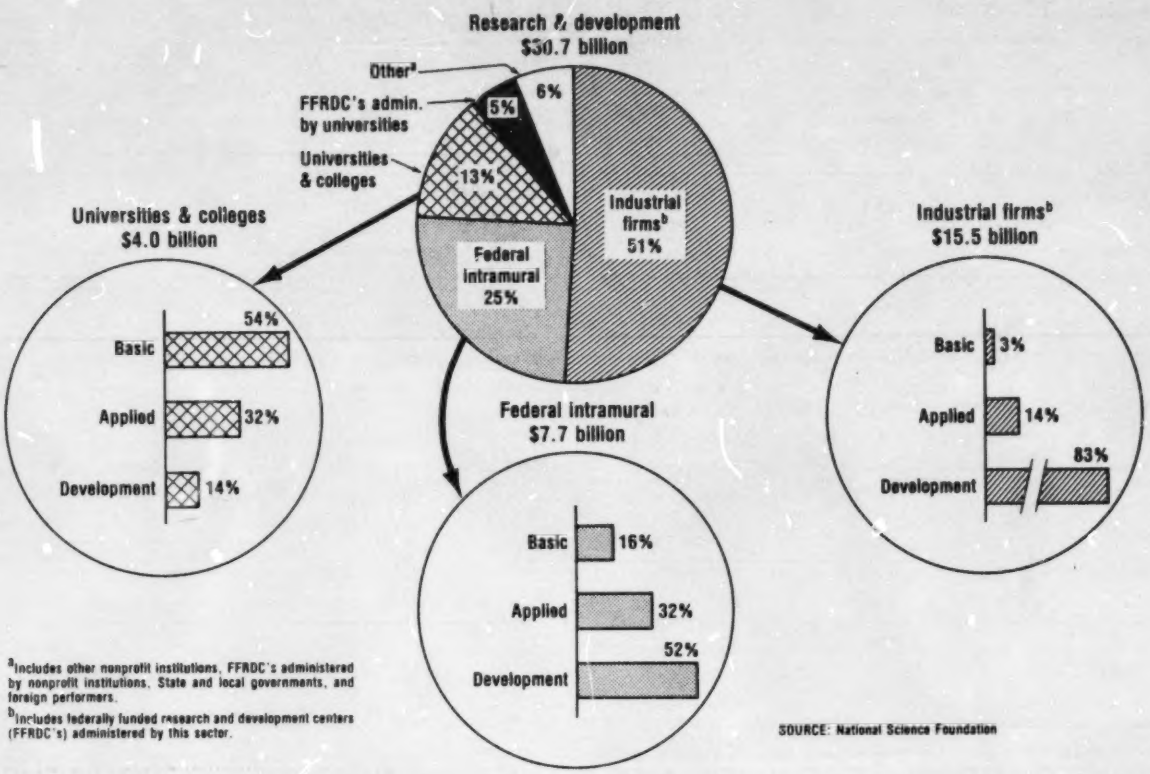
USDA R&D support within USDA reflected a virtual leveling off in the 1980 budget, but both houses of Congress have granted increases, and the compromise will probably produce a rise of approximately 5 percent. The chief area of support is found in Agricultural Research, covering plant and animal production, processing and distribution, and use of soil, water, and air. Next is Cooperative Research, mostly covering the work of agricultural experiment stations; the only notable budget increase was shown here, in a doubling of funds for competitive research grants. Forest Service research, next in size, was reduced, largely from cutbacks in surface environment and mining research and in forest insects and disease research.

Performers

As in recent years, three-fourths of Federal R&D performance in 1980, or $23.6 billion, is expected to be accomplished extramurally through grants and contracts. An estimated 51 percent of total Federal R&D obligations is expected to be provided to industrial firms (including FFRDC's),[1] 13 percent to universities and colleges, and 5 percent to other nonprofits (including FFRDC's) (chart 2). These shares have not greatly changed since 1970; the industry share is now somewhat lower and the academic share somewhat higher. The $7.7 billion that is expected to be performed intramurally, by Federal personnel directly or in the

[1] Federally funded research and development centers.

Chart 2. Federal obligations for research and development by performer and character of work: FY 1980 (est.)



[a]Includes other nonprofit institutions, FFRDC's administered by nonprofit institutions, State and local governments, and foreign performers.

[b]Includes federally funded research and development centers (FFRDC's) administered by this sector.

SOURCE: National Science Foundation

administration of extramural work, is 25 percent of the Federal R&D total, the same as in 1970.

During the 1970-80 decade universities and colleges have tended to represent an increasing share of total Federal R&D performance, as Federal research programs have expanded, and industrial firms to represent a decreasing share, as Federal development programs have reflected a steady level of effort or grown more slowly. Among major performers, universities and colleges have shown the most rapid average annual funding growth rate, 10.6 percent in the 10-year period (or real growth of 3.3 percent). Other nonprofits (including FFRDC's) have reflected a 7.7 rate, followed by university-administered FFRDC's and Federal intramural organizations, each with a 7.2 average annual rate. Industrial firms (including FFRDC's) have shown an average annual growth rate of 6.3 percent, or a 0.7-percent decline in constant dollars, the only performance sector with a real decline.

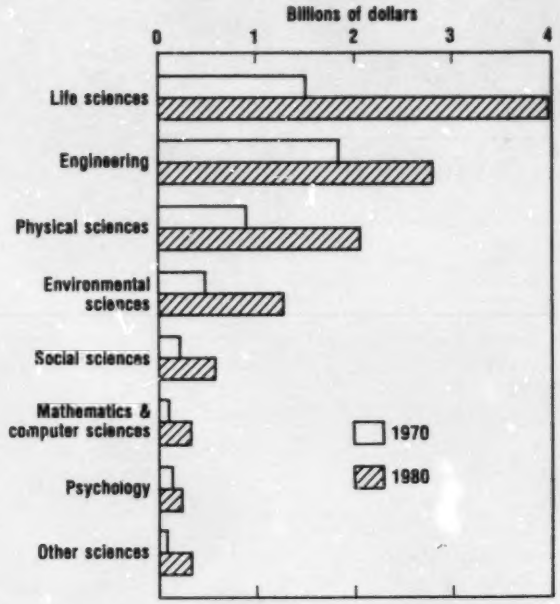
Industry is by far the leading performer of Federal development work, followed by Federal intramural laboratories and test facilities. Until 1976 the small growth in DOD and NASA programs was reflected in virtually unchanged levels of Federal R&D funding to industry, and even though the programs of these agencies and DOE have grown significantly since then, development funding did not surpass 1970 in real terms until 1979. The decline shown in the 1980 budget once more placed development funding behind 1970 in constant dollars.

Research programs, by contrast, reflected steady constant-dollar growth after 1975 until the 1980 budget. The chief performing sectors for research are the Federal intramural and the academic sectors, each with approximately one-third of the Federal research total (followed by industry with one-fifth). As research programs have grown, especially those of HEW (NIH) in biomedical areas, of NASA in space science and applications, of DOE in energy-related fields, of NSF in nonmission-oriented basic research support, and of USDA in agricultural pursuits, intramural and university R&D performance have expanded. Since 1970 both sectors have shown steady R&D current-dollar growth, but only since 1976 has growth been continuous in real terms. The 1980 budget interrupts this trend in both cases.

Fields of Science

The life sciences have been the most heavily supported research area since 1972 and will account for an estimated 34 percent of the $11.6 billion Federal research total in 1980 (chart 3). HEW, mainly through NIH biomedical research programs, has provided most of the support (approximately two-thirds of the life sciences total), followed by USDA in food and fiber research.

Chart 3. Federal obligations for research by field of science: FY 1970 and 1980 (est.)



SOURCE: National Science Foundation

Engineering remains the second largest field, making up 24 percent of the total in 1980. DOD and NASA provide two-thirds of the funds for research in this area, followed by DOE.

The physical sciences (astronomy, chemistry, physics), represent an estimated 18 percent of the total in 1980, with DOE, DOD, and NASA providing three-fourths of of the funding. The environmental sciences (atmospheric, geological, and oceanographic) are expected to account for 11 percent of the Federal research total, with NASA contributing one-third of the support.

The social sciences, with HEW alone providing more than two-fifths of the funding, will account for an estimated 5 percent of the 1980 research total.

Between 1970 and 1978 the most rapidly growing fields in terms of Federal support have been mathematics and computer sciences, social sciences, environmental sciences, and life sciences, in that order.

* * * * * * * *

Federal Funds for Research and Development, Fiscal Years 1978, 1979, and 1980, Volume XXVIII will discuss the survey findings in further detail, relating them to broader indicators and current issues. The report will be obtainable from the Superintendent of Documents, U.S. Government Printing Office. The detailed statistical tables (NSF 79-318) are obtainable on request from the National Science Foundation, Washington, D.C. 20550.

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